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Effects of mental training on muscular force, hormonal and physiological changes in kickboxers

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Table 1: Training session for both physical and mental groups.

Session phase (time)	Physical training	Mental training	Control Group
Warm-up (~15 min)	General and specific warm-up	General and a specific warm-up	
Strength exercises (~15 min)	-70% 1RM bench press (4 sets/8 repetitions) - 70% 1RM half-squat (4 sets/8 repetitions)	-70% 1RM bench press (4 sets/8 repetitions) - 70% 1RM half-squat (4 sets/8 repetitions) - Each exercise incorporated with motivational self-talk	No mental or physical training
Plyometric drills (~15 min)	- MBT (4 sets/10-12 repetitions) - CMJ (4 sets/10-12 repetitions)	- MBT (4 sets/10-12 repetitions) - CMJ (4 sets/10-12 repetitions) - Each exercise incorporated with motivational self-talk	
Other tasks (~30 min)	Neutral cognitive task	Imagined exercises -70% 1RM bench press (4 sets/8 repetitions) - 70% 1RM half-squat (4 sets/8 repetitions) - MBT (4 sets/10-12 repetitions) - CMJ (4 sets/10-12 repetitions) - Each exercise incorporated with motivational self-talk	
Cool down (~15 min)	Jogging, stretching, shadow boxing.		
Recovery between sets	All exercises with ~80 s of recovery between sets.		
Training Frequency	Completed 3 * per week, with a minimum of 1 rest day between training sessions (36 sessions over 12 weeks).		
Kickboxing session for both mental and physical groups (two 90 min training sessions per weeks over 12 weeks)	1- General and specific warm-up (~15 min). 2- Physical conditioning (20 min): sprint and endurance exercises. 3- Technical development (20 min): each athlete carried out a variety of kickboxing techniques (kicking, punching, combination of lower and upper limb) performed in either stationary or variable positions. Each technique lasted 2 min with 1 min of rest. 4- Tactical development (20 min): the athlete practiced various kickboxing techniques (kicking, punching, combination of lower and upper limb, striking and blocking) in different tactical sparring situations (offensive and/or defensive). Each bout lasted 3 min with 1 min of rest between bouts. 5- Cool down (~15 min)		

Note: 1RM: one repetition maximum; CMJ: counter movement jump; MBT: medicine ball throw. *The general experimental design is outlined in Figure 1.*

Table 2. Mean \pm SD values for muscular power and strength performance during 12-week of mental training in male trained kickboxers.

Variables	Period	Mental group	Physical group	Control group
CMJ (cm)	Before	32.6 \pm 2.6	33 \pm 2.5	32.5 \pm 2.6
	6 weeks	35.1 \pm 2.7	34.2 \pm 2.7	31.8 \pm 2.6
	12 weeks	37.9 \pm 2.8**£	35.8 \pm 2.7*†	30.3 \pm 2.8
MBT (m)	Before	4.3 \pm 0.3	4.2 \pm 0.3	4.2 \pm 0.3
	6 weeks	4.7 \pm 0.4*	4.5 \pm 0.4	4.2 \pm 0.4
	12 weeks	5.5 \pm 0.3**#	4.8 \pm 0.3*†	4.1 \pm 0.3
Bench press (kg)	Before	60.2 \pm 7.8	60.3 \pm 7.7	59.7 \pm 7.2
	6 weeks	66.4 \pm 8.5	64.2 \pm 8.1	57.2 \pm 8.1
	12 weeks	76.2 \pm 8.7**#	69.8 \pm 8.7*†	55.2 \pm 7.5
Half-squat (kg)	Before	89.2 \pm 12.5	90.1 \pm 13.4	88.9 \pm 12.7
	6 weeks	98.5 \pm 13.6	95.2 \pm 14.2	88.5 \pm 12.6
	12 weeks	113.5 \pm 14.1**#	104.8 \pm 14.7*†	83 \pm 13.4

Note: CMJ: counter movement jump; MBT: medicine ball throw; *: Significant difference at post-training compared with pre-training at $p < 0.05$; **: Significant difference at post-training compared with pre-training at $p < 0.001$; #: Higher values for the mental group at post-training compared to physical and control groups at $p < 0.05$; †: Higher values for the physical group at post-training compared to the control group at $p < 0.05$. £: Higher values for the mental group at post-training compared to the control group at $p < 0.001$.

Table 3. Mean \pm SD values for physiological variables during 12-week of mental training in male trained kickboxers.

Variables	Period	Mental group	Physical group	Control group
HR rest (beats/min)	Before	69.6 \pm 2.5	69.7 \pm 2.4	68.9 \pm 2.1
	6 weeks	67.9 \pm 3.1	68.8 \pm 2.6	69.2 \pm 2.4
	12 weeks	63.2 \pm 3.3** [#]	67.6 \pm 2.8* [†]	73.3 \pm 2.7
MABP (mmHg)	Before	89.1 \pm 2.3	90.2 \pm 2.6	89.2 \pm 2.2
	6 weeks	87.5 \pm 2.7	88.9 \pm 3.2	89.8 \pm 2.4
	12 weeks	81.5 \pm 3.1** [#]	85.4 \pm 3.5* [†]	91.8 \pm 2.6

Note: HR rest: resting heart rate; MABP: mean arterial blood pressure; *: Significant difference at post-training compared with pre-training at $p < 0.05$; **: Significant difference at post-training compared with pre-training at $p < 0.001$; [#]: Higher values for the mental group at post-training compared to physical and control groups at $p < 0.05$; [†]: Higher values for the physical group at post-training compared to the control group at $p < 0.05$.